Technical white paper

An Introduction to HP 3PAR StoreServ for the EVA Administrator

The pain free and risk free evolution for EVA

Table of contents

Introduction

This paper compares the architecture and features of HP EVA P6000 Storage with HP 3PAR StoreServ Storage. It also explains to EVA system administrators how to translate features of EVA to HP 3PAR StoreServ and describes HP 3PAR StoreServ Storage features not found on EVA systems. The paper also aids the reader in making the decision on which HP 3PAR StoreServ platform is optimal when migrating from a particular EVA P6000 system. It is assumed that the reader is familiar on the administrative level with the HP EVA P6000 models and their software. In the development of this paper, we used HP P6000 Command View 10.2 and XCS v11001000 for HP EVA P6000 Storage and compared these against Management Console (MC) 4.3 and HP 3PAR Operating System (OS) 3.1.2.

Array families

HP EVA P6000 Storage is in its fifth generation with more than 100,000 units sold worldwide, deployed across thousands of data centers. It is a proven solution for mid- to large-sized companies that need enterprise storage features at a reduced cost of ownership. HP EVA is supported by a powerful, yet simple suite of management software that makes it easy for users to provision storage and achieve improved levels of productivity. The newest generation of HP EVA known as EVA P6000 is characterized by improved performance and lower energy requirements. The **Edison Group's latest report**[1] shows HP EVA P6000 Storage is easier to manage than comparable storage arrays from NetApp and EMC.

At the time of writing the currently available HP EVA P6000 disk array models are the P6350 and P6550. Older HP EVA models include the 3000, 5000, 4000, 6000, 8000, 4100, 6100, 8100, 4400, 6400 and 8400 and the P6300, P6500 series. They differ mainly in controller type, expandability, supported host protocols, and backend disk type. All models have two controllers on board. The systems range in capacity from 8 to 450 disk drives and store up to 1.2 PB of data. More information on HP EVA P6000 Storage is available at **hp.com/go/EVA**.

HP 3PAR StoreServ Storage is in its third generation with HP 3PAR StoreServ 10000 and 7000 models. Previous generations were the E- and S-Class and the F- and T-Class. HP 3PAR StoreServ is designed to deliver Tier-1 utility-based storage in a secure multitenancy, mixed workload environment at enterprise-class virtual and cloud data centers. The use of unique, integrated thin technologies reduce acquisition and operational costs by up to 50 percent[2] while autonomic management features improve administrative efficiency.

HP 3PAR StoreServ 10000 Storage is available in two models: 10400 and 10800, while the HP 3PAR StoreServ 7000 Storage is available in the 7200 and the 7400 model. The F-Class comes in an F200 and F400 model. The third number from the right in the model string represents the maximum number of controllers the model can have. The number of controllers in HP 3PAR StoreServ is always even and varies between 2 and 8. Capacity ranges from 8 to 1920 disk drives and goes up to 1.6 PB. More information on the HP 3PAR StoreServ is available at **hp.com/go/3par**.

Terminology

HP EVA P6000 and HP 3PAR StoreServ are both virtualized storage arrays and hence have many similarities. But because of their development heritages, the terminology used to describe some array features and operations differ. Table 1 provides a comparison of each product's vernacular.

[1] **http://h17007.www1.hp.com/docs/whatsnew/Edison_HP_EVA_CMCS_White_Paper.pdf**

[2] Requires the use of HP 3PAR Thin Conversion Software and HP 3PAR Thin Provisioning Software. For details, refer to the Get Thin Guarantee Terms and Conditions. More information is available at **hp.com/storage/getthin**.

Table 1. Terminology comparison between EVA and HP 3PAR StoreServ

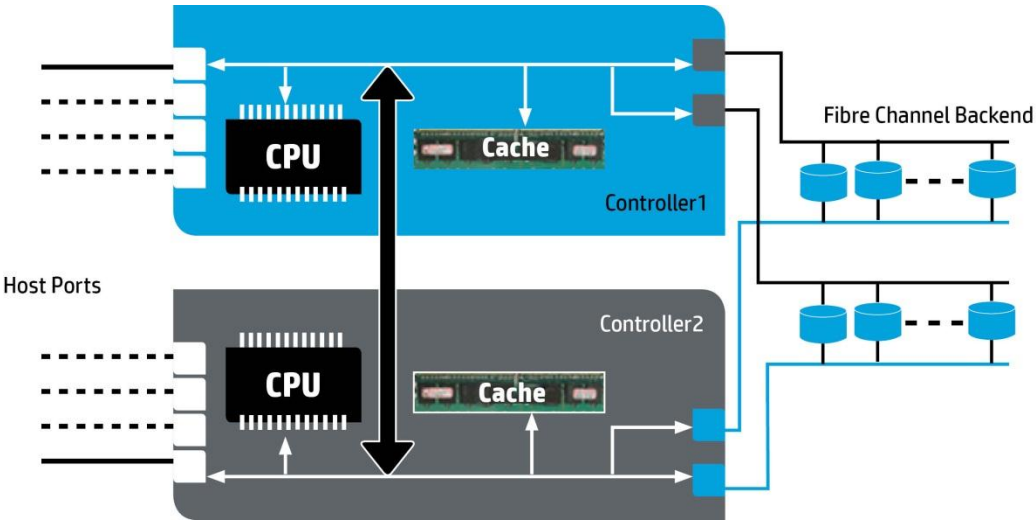
EVA P6000	HP 3PAR StoreServ
Controller	Node
P6000 Command View	Management Console (MC)
XCS	HP 3PAR Operating System (previously HP 3PAR InForm OS)
PSEG	Chunklet
Vdisk	Virtual Volume (VV)
Disk shelf	Drive chassis
Vraid	RAID
Thin provisioned Vdisk	Thin Provisioned Virtual Volume (TPVV)
Vdisk presented to a host	VV exported to a host
Disk Group	Common Provisioning Group (CPG)
Business Copy	Virtual Copy
Continuous Access	Remote Copy
Host Operating System Type	Host Persona
EVAPerf	System Reporter
Online Disk Migration, Leveling	Dynamic Optimization (DO)
Initialize the system	Execute Out-of-the-Box (OOTB) procedure

Architectural overview of EVA P6000 and HP 3PAR StoreServ

One of the many design objectives for HP EVA Storage was to provide maximum real-world performance while reducing the day-to-day operational work to manage the array. This objective resulted in the design of an intelligent controller pair with a minimal number of user-controllable tuning parameters. Thanks to the virtualization capabilities built into the controllers, the optimal layout of the space of a volume over the physical disks is taken care of behind the scenes without any user intervention. Figure 1 shows the block diagram of an EVA P6000 controller pair.

Independently, HP 3PAR StoreServ's design centers around the same concept: the operating system of the array optimizes the virtualization of volumes, their provisioning, and their I/O across all controller nodes in the system bringing operational efficiency yet flexibility to the daily management of the array.

Figure 1. Block diagram of a controller pair of an EVA P6000



HP 3PAR StoreServ systems features a modular, tightly coupled clustered architecture supporting 2, 4, 6, or 8 controllers or nodes. Each controller runs its own copy of the HP 3PAR Operating System (OS). There is no concept of managing individual nodes or node pairs in HP 3PAR StoreServ: the clustering software inside the OS makes the system appear from a managerial and operational perspective as a single cache-coherent system with a high level of resilience and no single points of failure. Figure 2 shows a picture of the controller nodes for the F-Class, StoreServ 7000, and StoreServ 10000 systems.

Figure 2. From left to right: an HP 3PAR StoreServ controller node for the F-Class, StoreServ 7000, and StoreServ 10000

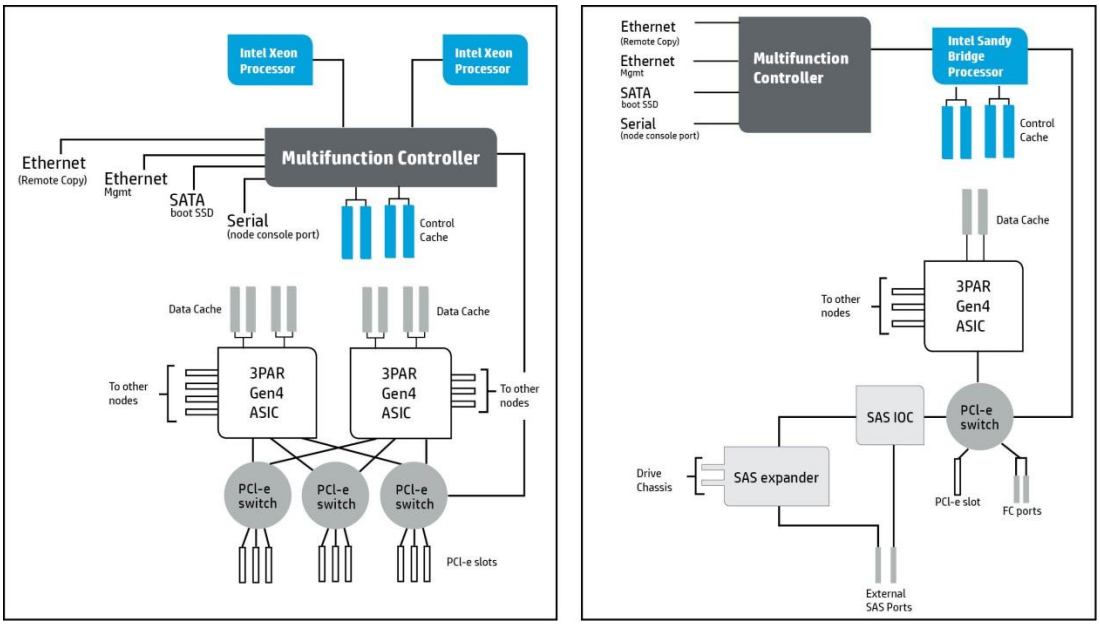
F-class controller

StoreServ 7000 controller

StoreServ 10000 controller

The architecture of an HP 3PAR StoreServ controller node centers around one (F-Class, StoreServ 7000) or two (StoreServ 10000) proprietary ASICs. The ASIC manages the data and control paths from the PCI interface cards to the data cache, the backend disks, the local CPUs, and the high-speed links towards the other nodes. Next to this, the ASIC performs all parity calculations for RAID operations, and features built-in zero detection capability used in thin provisioning to recognize and virtualize blocks of zeros inline. The ASIC drives fat-to-thin conversions and reclaims zeroed space on the array at wire speed. This offloads the CPUs in the controllers so CPU overload is rarely an issue with HP 3PAR StoreServ. The EVA P6000 controllers contain a similar ASIC for data movement and RAID calculations but it does not support zero space reclaim. The block diagram for an HP 3PAR StoreServ 10000 and 7000 controller node is shown in Figure 3.

Figure 3. Block diagram for an HP 3PAR StoreServ 10000 controller node (left) and an HP 3PAR StoreServ 7000 one (right)



Disk and host connectivity are strictly separated on the controllers in the EVA family: some ports on the controllers are dedicated to host facing and some are dedicated to disk facing.

With HP 3PAR StoreServ, disk and host connectivity is managed in a granular fashion by adding PCI expansion cards to the system with dual (F-Class) or quad (HP 3PAR StoreServ 7000 and HP 3PAR StoreServ 10000) FC ports or dual iSCSI ports per card. Each HP 3PAR StoreServ F-Class controller features two PCI-x expansion slots (plus one slot prepopulated with 4 FC ports), the HP 3PAR StoreServ 7000 controller has one PCI-e expansion slot (plus one slot prepopulated with 2 FC ports), the HP 3PAR StoreServ 10000 controller has 9 PCI-e expansion slots per controller node. All FC ports on a particular PCI card have to be dedicated to either host, disk, Peer or Remote Copy connectivity. This personality can be changed at any time. iSCSI only serves host connectivity. FC and iSCSI adapters are installed in the controllers following a preferred slot location scheme. Adding or removing PCI cards requires controller downtime but disk, host, Peer and remote replication access remains thanks to the node clustering if best practices of dual HBAs—dual SAN fabrics were applied when building the environment. Built into every controller node are a 10/100/1000 Mb/s Ethernet port for management and a 1 Gb/s Ethernet port for use with the HP 3PAR Remote Copy over IP software. Table 2 summarizes the number and type of expansion cards that an HP 3PAR StoreServ system can hold.

Table 2. Terminology comparison between EVA and HP 3PAR StoreServ

	F200	F400	7200	7400	10400	10800
Number of PCI slots per controller node	3*	3*	1**	1**	9	9
Total number of PCI expansion slots***	4	4,8	2	2,4	18,36	18,36,54,72
Built-in Remote Copy over IP ports***	2	2,4	2	2,4	2,4	2,4,6,8

* One slot is prepopulated with a quad-port FC card.
** One slot is prepopulated with a dual-port FC card.
*** Per 1, 2, 3, 4 controller pairs.

Like EVA P6000, the HP 3PAR StoreServ F-Class and HP 3PAR StoreServ 7000 are not cache-centric. The HP 3PAR StoreServ 10000 has a large amount of cache. Table 3 shows the cache sizes per system in GB per controller pair. For HP 3PAR StoreServ, the smallest number in the table is for one node pair, followed by the numbers for 2, 3, and 4 node pairs.

Table 3. Cache sizes in GB per controller pair for EVA P6000 and HP 3PAR StoreServ

Array	Model	Unified cache (GB)	Control cache (GB)	Data cache (GB)
EVA P6000	4000/4100/4400	4/4/4	-	-
	6000/6100/6400	4/4/8	-	-
	8000/8100/8400	8/8/14,22	-	-
	P6300/P6350	4/8	-	-
	P6500/P6550	8/16	-	-
HP 3PAR StoreServ	F200	-	8	12
	F400*	-	8,16	12,24
	7200	-	16	8
	7400/2**,7400/4***	-	16,32	16,32
	10400*	-	32,64	64,128
	10800*	-	64,128,192,256	128,256,384,512

* Per 1, 2, 3, 4 controller pairs.
** HP 3PAR StoreServ 7400 with two nodes.
*** HP 3PAR StoreServ 7400 with four nodes.

The large cache sizes for HP 3PAR StoreServ 10000 make these systems suited to support a very large number of I/O cards with high-speed interfaces like 8 Gb/s FC and 10 Gb/s iSCSI/ FCoE. The cache on EVA P6000 is unified while with HP 3PAR StoreServ, it is separated into Control and Data cache. Note that the cache sizes for all arrays in Table 3 are fixed and non-upgradable.

On HP 3PAR StoreServ, cache mirroring takes place between horizontally adjacent nodes. With four more nodes present, cache, the unique concept of Cache Persistence keeps the HP 3PAR StoreServ in Write-Through mode for writes to disk in the case a node in a node pair fails. See later in this paper for a discussion of Cache Persistence.

With F-Class and HP 3PAR StoreServ 10000, each node pair connects to one or more dual-ported disk enclosures called Drive Chassis at 4 Gb/s FC. Daisy chaining of drive chassis can happen with the F-Class. With HP 3PAR StoreServ 7000, the drive chassis connections run over 6 Gb/s SAS. The HP 3PAR StoreServ F-Class makes use of a drive chassis of 3U in size with 16 disk drives positions, each in their own carrier called a Drive Magazine. The drive magazine of an HP 3PAR StoreServ 10000 contains four disks of the same kind. The 10000 system drive chassis holds up to 10 drive magazines offering 40 disk drives in a 4U enclosure. On 7000, every drive magazine holds a single disk. Drive chassis come in a 2U enclosure with 24 2½" disks and in a 4U enclosure with 24 3½" units. Figure 4 pictures the drive magazines and drive chassis for the current HP 3PAR StoreServ models.

Figure 4. From top to bottom: a Drive Magazine and a Drive Chassis for the HP 3PAR StoreServ F-Class, HP 3PAR StoreServ 7200 Small Form Factor (SFF, 2½"), HP 3PAR StoreServ 7200 Large Form Factor (LFF, 3½"), and HP 3PAR StoreServ 10000

The disk drives in HP 3PAR StoreServ are of different types, form factors, size, and speed. Table 4 below gives the overview per HP 3PAR StoreServ.

Table 4. Drive and Drive Magazine characteristics for the current HP 3PAR StoreServ systems

Array model Parameter		F-Class	7000	10000
Drive protocol	Fiber	x	-	x
	SAS	x	x	x
Drive Magazine form factor	3½"	x	x	-
	2½"	-	x	-
Drive Magazine disk number	1 disk	x	x	-
	4 disks	-	-	x
Disk Drive form factor	3½" (LFF)	x	x	x
	2½" (SFF)	x	x	x
Drive size (GB) / Drive speed (rpm)	SSD	100/0k 200/0k	100/0k 200/0k	100/0k 200/0k
	FC	300/15k 600/15k	-	300/15k 600/15k
	NL	1000/7.2k 2000/7.2k	2000/7.2k 3000/7.2k	1000/7.2k 2000/7.2k
	SAS	300/15k 450/10k 900/10k	300/15k 450/10k 900/10k	300/15k 450/10k 900/10k

The drive magazines for the SAS drives in the F-Class and the 10000 are physically the same as for the FC drives but contain an FC-to-SAS convertor. SAS and FC drives can coexist inside one system. All drives in HP 3PAR StoreServ are dual-ported like on EVA. The SSDs are of the SLC type like on EVA.

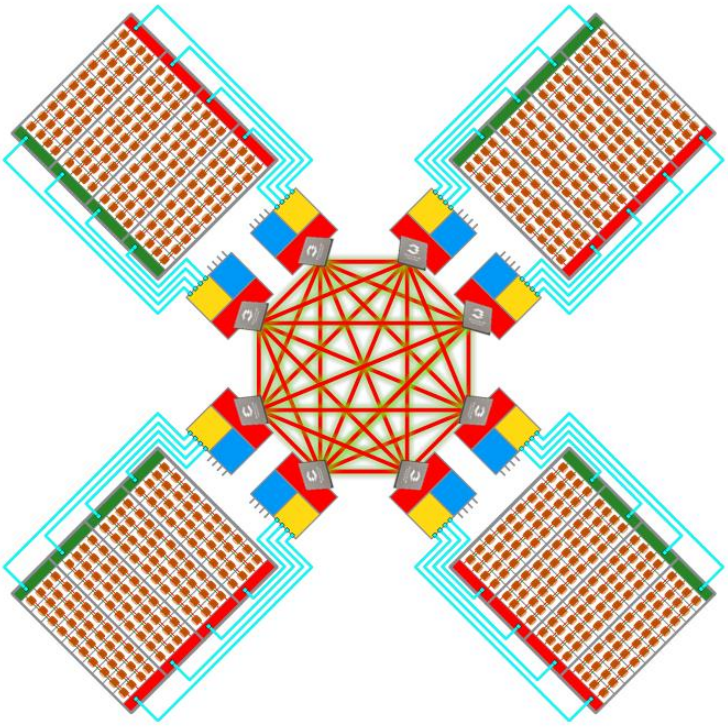
HP 3PAR StoreServ surpasses the EVA P6000 by far in drive count with the 10000 supporting up to 1920 units. Disk drive density in the rack is 10 LFF or 10 SFF drives/U on HP 3PAR StoreServ 10000. On HP 3PAR StoreServ 7000 we get to 6 LFF drives/U and 12 SFF drives/U, on the F-Class we get to 5.3 LFF or SFF drives/U. The EVA P6000 is at 6 LFF drives/U and 12.5 SFF drives/U. Table 5 lists the storage characteristics of HP 3PAR StoreServ.

Table 5. Storage characteristics for the HP 3PAR StoreServ

	F200	F400	7200	7400/2	7400/4	10400	10800
Number of drive chassis	2–12	2–24	1–6	1–10	2–20	4–24	4–48
Disk drives per drive chassis	16	16	24	24	24	40	40
Number of disk drives	16–192	16–384	6–144	6–240	12–480	32–960	32–1920
Maximum capacity (TB) (approx)	128	384	250	432	864	800	1600

The HP 3PAR StoreServ F-Class and HP 3PAR StoreServ 10000 feature a high-speed, full mesh, passive system backplane that interconnects the controller nodes in the system to form a cache-coherent, mesh-active cluster. Each controller node has a dedicated full duplex PCI-e link to each other nodes over the backplane offering a single hop distance between the nodes. With the 10000, these links operate at 2 GB/s each. On an 8-node 10000 system, a total of 28 bidirectional links are present on the array's backplane. In the F-Class models, the internode link speed is 800 MB/s in each direction. On the 7000, the nodes are linked by 6 Gb/s SAS cables. The low latency of the node interconnection allows for tight coordination among the controller nodes so they can present themselves as a single unit simplifying the software model. Figure 5 shows the interconnections between the controllers and the drive chassis for the 10800 with 8 nodes and 4 drive chassis per node pair.

Figure 5. Interconnection of the controller nodes and drive chassis for an 8-node HP 3PAR StoreServ 10800 with 4 disk chassis per node pair. The blue portion of the controllers interconnects to the SAN and the hosts (not shown). The red portions and the red lines centrally in the picture interface each node to all other nodes through a direct link on the backplane. The green portions interface the controller to the disk chassis.



A set of dual, rechargeable batteries in each of the controllers of the EVA provide power to maintain the contents of the Write-Back controller cache memory when AC power is lost or when the storage system has not been shutdown properly. When fully charged, the batteries can buffer the cache contents for up to 96 hours. HP 3PAR StoreServ systems saves the cache contents in case of an AC power loss differently. A redundant set of two batteries will provide power to each controller node long enough to enable the HP 3PAR OS transfer the contents of the Write cache of a node to a physical disk drive located inside the node enclosure. This way, the cache contents are buffered indefinitely long. With the HP 3PAR StoreServ F-Class, the disk is a 250 GB unit of the SATA type, with the 7000 a 50 GB MLC SSD and with the 10000 a 128 GB MLC SSD. The batteries are periodically tested by discharging one battery while the other remains charged and ready in case a power failure occurs while the battery test is in progress. HP 3PAR OS keeps track of battery charge levels and limits the size of the Write cache based on the ability of the batteries to power the controller nodes long enough to save their cache data to the local drive. Refer to the **HP 3PAR Architecture white paper**[3] for a detailed account of the hardware of an HP 3PAR StoreServ 10000 system.

With the HP 3PAR StoreServ F-Class and the 10000 comes a Service Processor (SP) server mounted in the same cabinet as the system's controller nodes. With the 7000, you can choose between a physical SP or a virtual one (VSP). The SP and the VSP provide remote error detection and reporting, and support diagnostic and maintenance activities on an HP 3PAR StoreServ system. It can be set up to "phone home" to HP 3PAR StoreServ over the public Internet or via modem.

[3] **http://h18006.www1.hp.com/storage/pdfs/4AA3-3516ENW.pdf**

Ordering and physical installation

Like EVA P6000 systems, all HP 3PAR StoreServ systems can be ordered preracked and precabled. The F200, F400, 7200, 7400, and 10400 systems can be field-racked in 19" HP 3PAR StoreServ and third party racks. Rack mount kits for all components of the array and PDUs need to be added to the order when field-racking. The 10800 can only be factory-racked in an HP-branded cabinet. The reason is that the backplane for this model is very large and needs to be installed with high precision onto a rack that is suitable to handle the weight of the controllers and their drive chassis and the vibrations of the spinning drives. This is important information for customers that standardize on a particular type of rack in their data centers and want to acquire the largest HP 3PAR StoreServ. Because of weight, the drive magazines are not installed in preracked systems but shipped in separate, disposable containers. Installation of the drive magazines follows a specific loading order that is described in the Installation Manual for the system. Mounting non-3PAR hardware like servers and switches in unpopulated space of an HP or third party HP 3PAR StoreServ rack is not supported. The HP racks for HP 3PAR StoreServ have locks on their front and rear doors, a requirement by many customers.

Starter Kits for an F200 and F400 are available, each with two controller nodes, 16 FC drives of 600 GB and a 10 TB license for the Thin Provisioning Suite. Starter kits for HP 3PAR StoreServ 7000 and 10000 are not available. A sizer tool to calculate the number of IOPS for a particular combination of controller nodes, drive chassis, drive magazines, and physical disk drive types is available through your HP Representative or an HP Partner.

Because of the number and size of the controllers and disk shelves, only the smaller HP 3PAR StoreServ can be housed in a single rack. A fully built-out F400 needs three racks, a maximized 10800 spans seven racks. HP 3PAR StoreServ 7000 systems fit in a single rack or in two of them. All controller nodes are always located in the first cabinet of a HP 3PAR StoreServ; any other cabinet in the configuration only contains drive chassis. For the HP 3PAR StoreServ F-Class and the 10000, the cabinets that make up the system don't need to be adjacent to each other because they are interconnected via FC: a distance up to 100 m is supported between the cabinet with the controllers and the ones with the drive chassis. This is an important benefit when planning rack space in the data center for later upgrades of the system. The interconnect for HP 3PAR StoreServ 7000 controllers and drive chassis is SAS and the cabinets need to be adjacent because of SAS cable length. For those that want to integrate HP 3PAR StoreServ in cabinets in the field, Table 6 lists the dimensions of the components. To reduce occupied space, the use of "zero U" PDUs is an option.

Table 6. Dimensions of HP 3PAR StoreServ components

	F200/ F400	7200/7400	10400/ 10800
Controller node pair	4U	2U/2–4U	15U
SFF Drive chassis	3U	2U/2U	4U
LFF Drive chassis	3U	4U/4U	4U
Service Processor (SP)	2U	1U	1U
Virtual Service Processor (VSP)	-	0U	-
Number of 19" racks in maximum configuration	2/3	1/1–2	4/7

While upgrades on EVA P6000 only involve adding disk shelves, HP 3PAR StoreServ can accommodate extra controller pairs and/or extra PCI adapter cards as well. Best practices dictate the location of FC and iSCSI adapter cards in the controller nodes. Not all combinations of node pairs, drive chassis, disk magazines, adapter cards, and adapter card locations are supported. Consult with your HP Representative or HP Partner for options to upgrade your system with predictable performance.

The minimum configuration for F-Class and 10000 systems is 2 controller nodes, 4 drive chassis and 8 drive magazines. As an exception the F-Class Starter Kits have only 2 drive chassis and 4 magazines. For HP 3PAR StoreServ 7000 the minimum system has 8 FC drive magazines inside one 2-node enclosure. The minimum configuration for an all-NL drive configuration is one 2-node enclosure without drives and 12 LFF NL drives in an additional enclosure. To stay within best practices for F-Class and 10000, disk drives should be added in multiples of 16 of each drive type and drive chassis should be added in multiples of 4. For HP 3PAR StoreServ 7000 the minimum upgrade is four disk drives per shelf.

A maximum of 32 SSD drives are supported per node pair on F-Class. On the 10000, we go up to 128 SSDs (32 drive magazines) per node pair. That means 10800 can support up to 512 SSDs when configured with four controller node pairs, this is much more than on any EVA P6000 system. The 10000 is also available as an all-SSD system. On the 7000 systems, the minimum number of SSDs is 8; the maximum is 120 on a 7200 and 240 on a 7400. An all-SSD 7000 system

will be available soon. The 7000 can be configured with a controller chassis without SFF drives and one or more LFF drive chassis.

The total weight of EVA P6000 and HP 3PAR StoreServ can be substantial and requires careful structural analysis with regard to the raised floors in data centers. Consult the product's **QuickSpecs** for the EVA P6000 and HP 3PAR StoreServ for details on the weight per controller node, drive chassis (empty and full), the rack itself and the Service Processor (if present). For HP 3PAR StoreServ, we support up to 900 kg per rack in use.

EVA P6000 and HP 3PAR StoreServ are powered by single-phase current. The HP 3PAR StoreServ 10000 systems are available with three-phase power as well. Preracked configurations come with PDUs with a choice of NEMA or IEC plugs. Every rack with HP 3PAR StoreServ equipment requires 4 PDUs with circuit breakers of 32A each. Note that even medium sized HP 3PAR StoreServ systems draw more current than EVA systems. The QuickSpecs and Physical Planning Guide (only HP employees and Partners can access this guide) for the HP 3PAR StoreServ list the power consumption per node and per drive chassis. Like on the EVA, all AC power inlets are redundant.

Because larger HP 3PAR StoreServ configurations are spread over multiple cabinets, thermal emission is higher than for most EVA systems. Details on the level of cooling required for the different HP 3PAR StoreServ models can be found in the Physical Planning Guide for a particular HP 3PAR StoreServ system. HP recommends that customers review the electrical and cooling requirements for HP 3PAR StoreServ systems during site preparation. Environmental specifications to store and operate EVA and HP 3PAR StoreServ systems are very similar. No special precautions for temperature and humidity are needed when adding HP 3PAR StoreServ systems to a data center.

Preracked EVA systems come with the disk drives installed and the wiring from the controllers to the disk shelves and the PDUs in place, applying power is all that is needed. For preracked HP 3PAR StoreServ systems, the cabling between the cabinets has to be fitted onsite.

The field installation of an EVA involves racking the controllers and disk shelves and interconnecting them by FC over copper cables. The wiring is simple and color-coded outlets are used on the rear of the controllers. Installing the PDUs and wiring them completes the physical installation of the EVA. The field installation of an HP 3PAR StoreServ system is different from EVA systems with regard to the FC cabling from the nodes to the drive chassis. Labeling of cables is worth the effort. Use cable routing guides and openings for FC, network and power cables at either side of the cabinets if available to ensure unobstructed access in case of removal and insertion of controller nodes, drive chassis, and the Service Processor. Note that the FC cables for HP 3PAR StoreServ are special in that they have a shorter boot at the LC connector than regular ones to ensure for a proper bend-radius with closed front and rear cabinet doors. For HP Partners, the review of the Installation and Deinstallation Guide for a specific HP 3PAR StoreServ is highly recommended. The HP 3PAR StoreServ Installation and Startup Service executes the necessary activities required to deploy your HP 3PAR StoreServ. Note that before powering on an HP 3PAR StoreServ, the system may require up to 24 hours to acclimatize to the new operating environment when outside-to-inside temperature conditions vary significantly.

Power up and initial configuration

The power up procedure for HP 3PAR StoreServ systems is comparable to that of the EVA. Set the power switch on the circuit breakers of the PDUs to the OFF position, connect AC power to the HP 3PAR StoreServ, set the power switch on each controller node and each drive chassis in the ON position and apply power by switching the circuit breakers to ON. LEDs on the system's components indicate the progress of the boot cycle that takes about 10 minutes to complete. Refer to the manuals for more information on the meaning of the LEDs.

After a successful boot cycle on the HP 3PAR StoreServ F-Class and the 10000, you can log on to the system using a terminal session from a Windows® PC and perform a system initialization called the "Out of the Box Procedure" (OOTB). This PC is connected to the system via a serial cable. Proceeding with the OOTB script causes complete and irrecoverable loss of data on the disk drives. The script prompts to supply the geographical location, time zone, and name for the system and writes details about the disk drive and controller hardware it found to the terminal screen. At this moment, verify if all hardware present physically shows up on screen. After operator confirmation, the script prompts for starting an optional system stress test checking the hardware thoroughly. Depending on the size of the system, this test varies between half an hour and a few hours. HP recommends completing this part of the startup script. After the stress test ends, entering the IP configuration for the system completes the initialization work. Next is the setup and configuration of the Service Processor (SP) server, a process called the "Moment of Birth" (MOB or SPMOB). After successfully completing the SPMOB, the HP 3PAR StoreServ is added to the configuration database of the Service Processor.

With the HP 3PAR StoreServ 7000, the customer has the choice between a physical Service Processor and a virtual one (VSP). The VSP is a VMware image that is deployed on VMware vSphere 4.1 and higher. With either a physical or virtual SP, the HP 3PAR StoreServ 7000 can be set up as described above. Alternatively, the HP 3PAR SmartStart software can be used to install the SP or VSP and configure the HP 3PAR StoreServ 7000 system. This software that finds its roots in EVA is a wizard that takes the user through all steps needed to initialize HP 3PAR StoreServ 7000, configure FC and iSCSI host connections and an initial set of virtual volumes, install the 3PAR Management Console software and deploy the SP or VSP. The HP 3PAR SmartStart software wizard runs on Microsoft® Windows Server 2008 R2.

Host connectivity

HP EVA P6000 supports FC, iSCSI, and FCOE host connectivity depending on the models. HP 3PAR StoreServ systems support a mix of FC and iSCSI with FCOE available soon. Table 7 lists the natively supported protocols and the number of interfaces on the various EVA P6000 and HP 3PAR StoreServ models. Numbers in the table section for HP 3PAR StoreServ that are separated by commas hold for 2, 4, 6, and 8 controllers.

Table 7. Native connectivity protocols with number of host ports per protocol for EVA P6000 and HP 3PAR StoreServ per node pair

Array	Model	FC	iSCSI	FCOE
EVA P6000	4000/4100/4400	4/4/4 or 20*	-	-
	6000/6100/6400	4/4/8	-	-
	8000/8100/8400	8/8/8	-	-
	P6300/P6350	8	-	-
		4	8@1 Gb/s	-
		4	4@10 Gb/s	4@10 Gb/s
	P6500/P6550	8	-	-
		4	8@1 Gb/s	-
		4	4@10 Gb/s	4@10 Gb/s
HP 3PAR StoreServ	F200	0–12	0–8	-
	F400	0–12, 0–24	0–16	-
	7200	4–12	0–4	Coming soon
	7400/2**	4–12	0–4	Coming soon
	7400/4***	8–24	0–8	Coming soon
	10400	0–48, 0–96	0–16	Coming soon
	10800	0–48, 0–96, 0–144, 0–192	0–32	Coming soon

* The EVA 4400 has the option for a controller that contains a 12-port embedded switch of which two ports are mapped to the two host ports on the controller.
** HP 3PAR StoreServ 7400 with two nodes.
*** HP 3PAR StoreServ 7400 with four nodes.

From Table 7 we learn that EVA P6000 systems have significantly less I/O interfaces than most HP 3PAR StoreServ systems. Throughout the generations of the EVA P6000 and HP 3PAR StoreServ models, the host connectivity speeds increased following the market trends. Table 8 gives an overview of the native speeds per protocol for the systems.

Table 8. Host connectivity speed for EVA P6000 and HP 3PAR StoreServ

Array	Model	FC (Gb/s)	iSCSI (Gb/s)
EVA P6000	4000/4100/4400	2/4/4 or 8	-
	6000/6100/6400	2/4/4	-
	8000/8100/8400	2/4/4	-
	P6300/P6350	8/8	1,10
	P6500/P6550	8/8	1,10
HP 3PAR StoreServ	F200	4	1
	F400	4	1
	7200	8	10
	7400	8	10
	10400	8	10
	10800	8	10

All models in both array families support the MPX200 Multifunction Router to provide additional 1 Gb/s and 10 Gb/s iSCSI and FCoE and 1 Gb/s FCIP connectivity.

Host connectivity for EVA P6000 and HP 3PAR StoreServ covers the usual range of operating systems. Note that they differ in that the EVA P6000 supports OpenVMS on Alpha and Itanium®, Tru64 (except for the new P6xx0 models) and Apple Mac OS X. Direct connect over FC to hosts is supported for all EVA P6000 and HP 3PAR StoreServ but consult the list of certified HBAs and their firmware. The same holds for boot from SAN: it is supported on both platforms but refer to the certified HBA list. Refer to the **HP SAN Design Reference Guide** and **SPOCK** (Single Point of Connectivity Knowledge) for more detailed information.

The maximum number of hosts on the EVA 4x00, 6x00, and 8x00 is 256 and 512 for the P63x0/65x0. For HP 3PAR StoreServ this number depends on the number of controller nodes in the system. For the 8-node 10800 up to 2048 initiators are supported, for all other HP 3PAR StoreServ models this value is 1024, independent of the HP 3PAR OS version. HP recommends that you connect a host with maximum two paths to an HP 3PAR StoreServ even if the array has four or more controller nodes. Because the cluster of controller nodes presents itself to hosts as a single system, servers can access VVs over any host port in the system. VMware hosts should use up to four paths to an array. HP strongly recommends single initiator—single target zoning between a host HBA and a host port on the HP 3PAR StoreServ to improve performance, security and fault isolation, and decrease troubleshooting time.

Host sets on HP 3PAR StoreServ group hosts allowing all hosts that are a member of the host set to see the same list of volumes. A virtual volume exported to one of the host set members becomes visible for all members, any host added to the host set automatically sees all exported volumes. This concept is particularly interesting when working with clusters of Windows, VMware and Hyper-V.

Managing the system

The Graphical User Interface (GUI) for managing and monitoring EVA P6000 systems is P6000 Command View, previously called HP Command View EVA. It is a comprehensive software suite designed to simplify array management, space provisioning and performance monitoring of all HP EVA P6000 family of storage arrays. The suite contains the products HP P6000 Command View, HP P6000 Performance Advisor, HP P6000 Performance Data Collector, HP SSSU, HP SMI-S EVA, and HP Management Integration Framework.

The GUI to manage HP 3PAR StoreServ systems is called the HP 3PAR OS Management Console or MC. The Management Console is a point-and-click GUI for all HP 3PAR StoreServ models and provides the instrumentation to manipulate the virtualized physical and logical objects in the system to provision volumes, snapshots, etc. and export them to hosts. The Management Console requires a physical or virtual server running a suitable version of Windows or Red Hat Linux. It is Java-based, does not require a web browser and is light-weight on computer resources needed. The list of TCP ports in use by the MC is available from an HP Representative or your HP Partner. No array-based Management Module like on the EVA P6000 is available. Secure access to the Management Console is possible. Unlike EVA, no FC connection is needed from the Management Console server to the HP 3PAR StoreServ; an Ethernet network connection is sufficient.

Comparable to P6000 Command View, a maximum of 16 systems can be managed from a single Management Console instance. Unlike in P6000 Command View, an HP 3PAR StoreServ can be managed by multiple instances of an MC at the same time. Grouping virtual volumes in folders in the MC like on Command View is not possible but you can filter on any item in any column in the provisioning screen to select volumes in the GUI. Nearly every table and piece of information on screen in the MC can be exported to a file or the clipboard in CSV or HTML format going beyond what P6000 Command View offers. A simulator for an HP 3PAR StoreServ 7200 running 3PAR HP OS 3.1.2 is available.

The Management Console provides a limited set of real-time statistics on the operation of an array; for full performance information, HP 3PAR StoreServ offers the software called System Reporter (described in more detail later in this paper).

HP 3PAR StoreServ offers a unique tool called Host Explorer. Installed on hosts that draw LUNs from an HP 3PAR StoreServ, it allows the Management Console to collect detailed host configuration information such as the OS type and version, WWN of HBAs, the iSCSI name and host multipathing information over a secure communication channel. This helps to reduce the manual administration to find these details per host.

The Command Line interface (CLI) for HP 3PAR StoreServ is richer than EVA's SSSU. The number of commands and their options exceed those in SSSU and the commands reveal information about volumes, logical disks (LD), free, used and sparing chunklets, the mapping of LDs on chunklets, the mappings of LDs to volumes, the mapping of a volume to physical disks, and more. The CLI client software uses TCP port 5782 for non-secure and 5783 for secure communication and is available for Windows, Solaris, HP-UX, and Linux. Consult **SPOCK** for the exact version of the supported operating systems. HP 3PAR StoreServ supports Secure Shell (SSH) protocol version 2 enabling great flexibility in accessing the HP 3PAR OS CLI server and provides an alternative to installing a local CLI client. Public-private key encryption algorithms can encrypt all traffic between the client and server and offers secure passwordless login. Particular actions can only be completed from the CLI like replacing or relocating a disk drive or drive magazine, drive chassis or node and more complicated forms of volume remote replication. Help on the various commands is available from within the CLI. Unlike EVA, no command is available to capture the configuration of an HP 3PAR StoreServ for cloning purposes.

Like EVAs, HP 3PAR StoreServ support open administration through SMI-S and SNMP. The SMI-S version implemented is 1.4 with Profile extensions for a set of Indications and to extract HP 3PAR StoreServ specific information. The CIM server is located inside HP 3PAR OS running on the controller nodes and not in the P6000 Command View like on the EVA. SMI-S is not enabled by default and is started and stopped from the HP 3PAR CLI. HP Storage Essentials and Microsoft System Center Virtual Machine Manager (SCVMM) 2012 discover the details of all HP 3PAR StoreServ models via SMI-S. SNMPv3 is supported by a MIB that can be downloaded at no cost. Configuration of SNMP including defining the trap-forwarding host happens via the CLI. Alert level filtering has to be implemented on the log host itself.

Capacity provisioning

Provisioning capacity to hosts is the core task of a storage array. HP EVA P6000 and HP 3PAR StoreServ excel in simplifying this task by virtualizing the physical storage available in the system.

HP 3PAR OS approaches the provisioning of space in a system by creating a three-level virtualization scheme. On the lowest level it subdivides the space on physical drives into so-called chunklets, each of which can be viewed as a small disk drive of 256 MB on the HP 3PAR StoreServ F-Class and 1 GB on the 7000 and 10000. RAID sets are constructed by grouping the suitable number of chunklets taken from distinct drives of the same media type (SSD, FC, or SATA). The RAID sets are assembled into Logical Disks (LD). The LDs are concatenated to form a virtual volume (VV) that is the top-level object in the virtualization scheme. By widely striping each virtual volume over chunklets from many physical drives, a much higher random performance is achieved than if the RAID sets were constructed from whole disks resulting in a few drives only taking part in the I/O of volumes. This wide-striping for every virtual volume results in no hot spots limiting the performance. The EVA's PSEG unit of 2 MB in size is comparable in concept to 3PAR's chunklet.

A fully provisioned volume has its own, private LDs whose combined size is the size of the VV. Thin provisioned volumes share their LDs among other thin provisioned volumes. Thin LDs are expanded as needed in predefined increments (32 GB by default for FC drives). Thin provisioned volumes are compatible with any type of local and remote replication.

The choice of RAID protection levels for virtual volumes is larger on HP 3PAR StoreServ than on EVA with more space efficient variants for RAID5 and RAID6 and superior protection for RAID1. More details on HP 3PAR StoreServ RAID implementations are described in this **paper**[4]. The RAID calculations required on EVA P6000 and HP 3PAR StoreServ are executed by ASIC(s) inside the controllers offloading their CPUs. Table 9 lists the available RAID levels on HP 3PAR StoreServ.

Table 9. RAID levels supported on HP 3PAR StoreServ

Protection level	Number of copies	Data + Parity	Storage efficiency
RAID0	0	1+0	100%
RAID1	1	2+0	50%
RAID1	2	3+0	33%
RAID1	3	4+0	25%
RAID5	0	2+1	66%
RAID5	0	3+1	75%
RAID5	0	4+1	80%
RAID5	0	5+1	83%
RAID5	0	6+1	86%
RAID5	0	7+1	88%
RAID5	0	8+1	89%
RAID6	0	6+2	75%
RAID6	0	14+2	88%

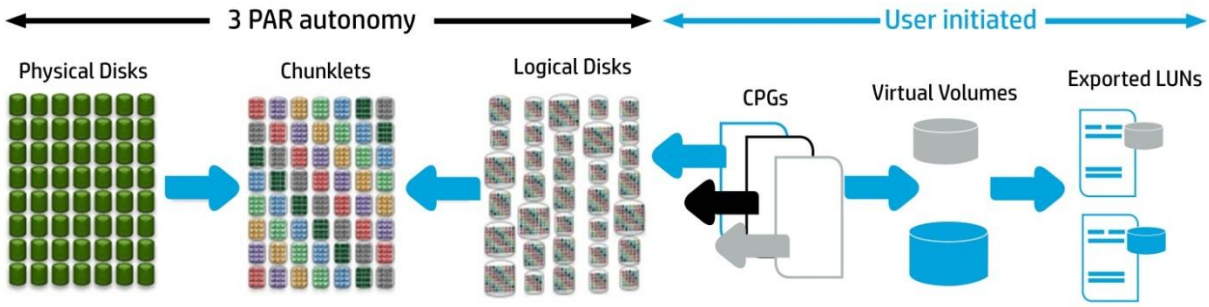
HP recommends using RAID6 on NL drives to cope with the long rebuild times in case of disk failure.

HP 3PAR OS implements the unique concept of a Common Provisioning Group (CPG) to provision volumes. A CPG is a template grouping characteristics typical for a volume such as disk media type, disk speed, RAID level, and availability level among others. A CPG can only contain one type of disk media and, although not recommended, one can filter the disk list of a particular media type to allow the CPG access only a subset of them. CPGs can have overlapping drive spindles. From the point of view of a consumer of space, a CPG can be seen as a "service level" for data storage. For a system administrator, a CPG is a policy for how free chunklets within the HP 3PAR StoreServ array should be selected to form virtual volumes. Both fully and thin provisioned volumes can be drawn from the same CPG. Volumes can be created quickly by selecting a CPG and supplying a name, size, and provisioning type for the volume. CPGs are pool-less in the sense that no space is reserved upfront for each CPG created: CPGs grow as needed according to their predefined growth increment. Safety mechanisms such as growth alerts and growth limits are built into HP 3PAR OS to prevent a CPG from consuming all free space on the system.

Volumes can be exported over one or more paths to one or more hosts and are called VLUNs or "Volume-LUNs". A VLUN is the representation of a single path between a volume and a host. VLUNs have a LUN id ranging from 0 to 16383. They can be marked read-only at export. Note that LUN id 254 is not available for export as it is reserved for communication with the Host Explorer agent. Figure 6 illustrates the virtualization levels within a HP 3PAR StoreServ.

[4] **http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA3-4815ENW.pdf**

Figure 6. Space virtualization on HP 3PAR StoreServ



Full and thin VVs are supported in sizes from 1 GB to 16 TB in 1 GB increments. That is the same increment as on the EVA P6000 but that platform allows for 32 TB or double the maximum volume size. Volume sets on HP 3PAR StoreServ systems allow up to 999 virtual volumes with the same characteristics to be created with only a few mouse clicks. Volume templates with predefined characteristics allow the quick creation of similar Vdisks. The maximum number of Base VVs (Full or Thin provisioned) is 4096. The combined maximum number of volumes = number of Base volumes + Virtual Copies (snapshots) + Full Copies is 8192 on F-Class and on the 7000 and 12288 on the 10000. The maximum number of VLUNs per host is 16383, the maximum per system is 32768. The maximum number of CPGs per system is 2048. The maximum number of volumes per CPG is 8192 on the F-Class and on the 7000 and 12288 on the 10000. CPGs with exactly the same characteristics but a different name can exist on a single system allowing you to group and easily identify volumes created for a particular workgroup in a company. Reporting tools like HP 3PAR's System Reporter can summarize space usage per CPG for chargeback.

The HP 3PAR Management Console offers an easy-to-use GUI for volume creation, provisioning, and snapshotting. The HP 3PAR CLI is equally versatile to create and manipulate volumes. The default provisioning type is thin with zero detect enabled. Volume provisioning for HP 3PAR StoreServ through Storage Essentials and HP Insight Control Storage Module for VMware vCenter is not supported, HP 3PAR Management Plug-In for VMware vCenter can create datastores and volumes on HP 3PAR StoreServ systems from predefined templates.

Unlike on EVA, HP 3PAR StoreServ offers thin provisioning built-in assisted by its 4th generation ASIC. The reclamation of deleted space on thin provisioned volumes on the system is based on an external script writing blocks of zeros to the deleted and unused portions of a volume. The ASIC then automatically marks these blocks as reusable by the array. No post-processing is necessary as on other platforms. Integration with Veritas Storage Foundation and Oracle ASM Storage Reclamation Utility (ASRU) provides an even higher level of thin provisioning space operational overhead savings. The T10 UNMAP command is fully supported on thin provisioned volumes on HP 3PAR StoreServ running VMware, Windows Server 2012, and Red Hat Linux 6.

Volumes can be converted from full to thin and from thin to full provisioning without I/O interruption from within the Management Console or the CLI. In conjunction with Windows Server 2012, HP 3PAR StoreServ supports Offload Data Transfer (ODX) on Hyper-V 3.x.

Disk sparing

Physical disk drives have a mean time between failures (MTBF) that is not infinite so the IT industry implemented a strategy in their arrays to cope with the reconstruction of data from failed drives. Both EVA and HP 3PAR StoreServ go beyond the simplest form of disk sparing where entire disks are dedicated as spare drives and only used in case of a drive failure.

The EVA implements a concept called Distributed Sparing where a fraction of every disk in a disk group is set aside as room to accommodate data that gets reconstructed from a failed disk. Rebuilding the data of a failed disk happens automatically and across the disk group instead of to a single dedicated drive. Distributed Sparing keeps all drives in the disk group spinning and contribute to the disk group performance.

The concept of Distributed Sparing is also implemented in HP 3PAR StoreServ. All disk drives in the system regardless of their media type have a user selectable, equal percentage of chunklets reserved for sparing purposes. If a disk drive fails, an automated rebuild of the data of the failed drive occurs on spare chunklets on drives of the same media type using the RAID parity information. The spare chunklet pool for a particular media type of disks is maintained across all disks of that media type in the system, which results in extremely short rebuild windows and little to no performance impact during the rebuilds. For thin provisioned volumes, only the chunklets that have been written to will be rebuilt.

The sparing protection policy is defined during the initial setup of a HP 3PAR StoreServ. You can choose between "Minimal", "Default", "Maximal" or "Custom" sparing. The "Maximal" policy guarantees enough spare chunklets on the disks inside each drive chassis to rebuild a failed drive in it that was 100 percent in use. In the other sparing policies, spare chunklets from other drive chassis may be used to rebuild a failed drive. In the "Custom" option, the number of spare chunklets has to be specified. The Management Console and the HP 3PAR CLI show the spare chunklets per physical disk. You can change the sparing policy online using the CLI. The HP 3PAR OS Concepts Guide provides more information on chunklet sparing.

Software portfolio

Today a comprehensive software portfolio is a vital part of the ecosystem of a storage solution. Features like a full-function GUI and CLI management interface, efficient thin provisioning, extensive local and remote replication options and integrations with well-known applications play an equally important role as the hardware itself when customers make the decision on the purchase of a storage system. EVA P6000 and HP 3PAR StoreServ both offer a broad range of software with their array. Table 10 lists the available software titles for both platforms. All titles are available across all systems in the array family.

Table 10. Software portfolio for EVA P6000 and HP 3PAR StoreServ

Functionality	EVA P6000	3PAR StoreServ
Management console	P6000 Command View	HP 3PAR OS Management Console (MC)
Command Line interface	SSSU[5]	3PAR CLI
Full provisioning	Y	Y
Thin provisioning	Y	Y
Thin Conversion	N	Y
Thin Persistence	N	Y
Thin Reclamation	N	Y
Thin Copy Reclamation	N	Y
Capacity-free snapshots	On-demand snapshot	Virtual Copy
Preallocated snapshots	Fully-allocated snapshot, Snapclone	N
Snapshots to different RAID level	Y	Y
Volume mirroring/resync after fracture	MirrorClone/Y	Physical Copy/N
Job scheduler	Y (via RSM[7])	Y
Host information discovery	N	Host Explorer
Local replication	Business Copy	Virtual Copy
Remote replication (Sync/Async Journal/Async Periodic)	Continuous Access (Y/Y/Y)	Remote Copy (Y/N/Y)
Cluster extension	CLX[6]	CLX
Distant clusters	MetroCluster/ContinentalCluster	MetroCluster
3 Data Center configuration	Y through snapshots	Synchronous Long Distance (SLD)
Consistency Groups for Remote Replication	Y	Y
Online LUN tier migration	Y	Dynamic Optimization
Sub-LUN tiering	N	Adaptive Optimization
Disk leveling	Y, automatic	Manual with Dynamic Optimization—automatic on HP 3PAR StoreServ 7000

[5] Storage System Scripting Utility
[6] Cluster Extension

Performance analyzer	EVAPerf, Performance Advisor	System Reporter
Multi-tenancy	N	Virtual Domains
Role-based administration	Y (3 roles)	Y (8 roles)
Volume retention	Y	Virtual Lock
Volume creation templates	Y (via RSM[7])	Y
Host and volume grouping	Y (Through RSM[7])	Y (Autonomic Groups)
Volume resizing automation	Dynamic Capacity Management (DCM)	N
Point-in-time recovery for applications	Application Recovery Manager (AppRM), SAP System Copy	Recovery Manager for VMware, Oracle, Microsoft Exchange, Microsoft SQL Server
Persistent ports	N	Y
VMware vCenter management plug-in	N	Y
VMware VAAI support	Y	Y
VMware UNMAP/TP STUN /TP LUN Reporter/Quota Exceeded support	N/N/N/N	Y/Y/Y/Y
VMware VASA support	Y	Y
Peer Persistence for VMware	N	Y
Storage Replication Adapter for VMware vCenter SRM	Y	Y

[7] Replication Solution Manager

From Table 10 we see that HP 3PAR StoreServ excels with a complete portfolio of thin technologies to start, get, and stay thin and to recover deleted space. HP 3PAR StoreServ systems also fits the needs of Storage Service Providers who appreciate the technology of HP 3PAR Virtual Domains Software, capable of providing up to 1024 secure “virtual private arrays” within a single, massively scalable HP 3PAR StoreServ. This administrative segregation of users, hosts, and application data between internal or commercial customers on the array in combination with role-based administration allows an unprecedented, highly secure “customer self-service” for volume creation and presentation.

The HP 3PAR Recovery Manager Software optimizes the interaction between HP 3PAR StoreServ systems and highly popular applications of Oracle, Microsoft SQL, Microsoft Exchange, and VMware. See later in this paper for a discussion on this industry-leading integration.

EVA offers a more expanded range of local replication options than HP 3PAR StoreServ including the possibility to resync a fractured mirror copy with its source and the “fully-allocated snapshot” ensuring that the disk group will not run out of space during snapshot writes. The scalability and performance of snapshots on HP 3PAR StoreServ are however far ahead compared to EVA. See later in this paper for a discussion on local replication on HP 3PAR StoreServ.

EVA and HP 3PAR StoreServ can lock volumes and volume copies from intentional and unintentional deletions. EVA allows placing or removing a Management Lock on a volume. HP 3PAR Virtual Lock software is more versatile in that a retention period of up to five years can be specified with a granularity of one hour.

HP 3PAR Autonomic Groups software allows for the creation of groups of hosts, volumes, and domains to automate and expedite storage provisioning. Autonomic Groups reduces human error by eliminating the manual repetition of tedious commands like provisioning multiple disks to multiple hosts. This software feature also simplifies reporting by enabling users to pull e.g. disk utilization statistics from clusters with just a single command. Autonomic Groups allow multiple independent virtual domains to be grouped as a single logical entity to simplify storage administration while maintaining the integrity of individual virtual domains.

HP 3PAR OS integrates a powerful scheduler for management automation. This tool reduces administration time and decreases the chances of human errors.

When a disk drive is added to or removed from an array, the data has to be redistributed over the physical disks present in a process called leveling. On EVA P6000, this leveling process starts automatically when needed. When adding disks or controller nodes to an HP 3PAR StoreServ F-Class and the 10000, the chunklet and LD imbalance is fixed manually or by using the optional HP 3PAR Dynamic Optimization (DO) software. The rebalancing happens across a single CPG or the entire array. On the HP 3PAR StoreServ 7000, this leveling happens automatically without the need for a DO license. The **HP 3PAR Rebalance Service**[8] optimizes resources in a system after hardware upgrades.

Both platforms offer equivalent solutions on local and remote replication that are discussed in more detail in a later chapter in this paper.

Application integration

Application integration is important in the operation of an IT organization. GUIs and template scripts to automate recurring operations remove the risk for human error in manipulations of critical data of applications.

The EVA P6000 offers application integration with a range of widespread application software from HP and other vendors. The HP 3PAR StoreServ also integrates well with a number of widespread applications. Here are a few examples:

1. HP System Insight Manager (SIM), Storage Essentials, and Microsoft System Center Virtual Machine Manager (SCVMM) discover, monitor, and inventory the HP 3PAR StoreServ family, and can create SAN topology drawings.
2. For high availability, HP 3PAR StoreServ is integrated into Serviceguard for HP-UX and CLX for Windows and Linux.
3. HP 3PAR Recovery Manager offers integrated business continuity with Oracle 10g and 11i and Oracle RAC (with integration for Oracle Active Data Guard), VMware 4.x and 5.x, Exchange 2007 and 2010 and Microsoft SQL 2005, 2008 and 2012. The Recovery Manager software leverages the Virtual Copy software to create and keep online hundreds of space-efficient, application-consistent snapshots for the granular and rapid recovery of virtual machines, individual files in virtual machines, applications, mailboxes, databases and tables in them. The snapshot instances are managed efficiently from an easy-to-use GUI that reduces administration time and human error. The HP 3PAR OS Scheduler can automate the periodic snapshot creation. Integration with HP Data Protector and Symantec NetBackup reduces the time to set up and take backups of the snapshots.
4. The HP 3PAR StoreServ F400 and the 7000 and 10400 systems form the storage in the HP VirtualSystem VS3 based on HP BladeSystem c-Class blade servers and VMware vSphere or Microsoft Hyper-V for server virtualization. HP VirtualSystem configurations are prewired, preconfigured, tested and precision tuned rack solutions delivering best-in-class cloud computing and virtualized data centers. As an example of the scalability, up to 6000 VMware virtual machines can be installed on a single VS3 system with an HP 3PAR StoreServ 10400 as the storage component.
5. HP 3PAR StoreServ has the tightest integration with VMware in the industry. The very high performance of the array with its wide striping and the advanced support of VMware's vSphere Storage APIs Array Integration (VAAI) capabilities enable organizations to double the virtual machine density on physical servers[9] when using HP 3PAR StoreServ as their backing storage. The HP 3PAR Management Software Plug-In for VMware vCenter allows administrators who are not HP 3PAR experts to use vSphere API for Storage Awareness (VASA) to identify, monitor, and assign HP 3PAR StoreServ storage volumes to VMs from within the vSphere console. HP 3PAR Recovery Manager Software for VMware vSphere uses HP 3PAR Virtual Copy Software to create point-in-time, VM- or application-aware, disk-based snapshots giving VMware administrators a simple process for recovering whole Virtual Machine Disks (VMDKs), individual Virtual Machine (VMs), or individual files inside virtual machines. HP 3PAR Replication Adapter Software for VMware vCenter SRM provides simple and reliable replication and disaster recovery for VMware vSphere environments based on HP 3PAR Remote Copy Software. Peer Persistence, a new feature of HP 3PAR OS 3.1.2, implements the migration of VMs between two vCenter instances for maintenance, load balancing, or disaster recovery without I/O disruption to the applications.
6. HP 3PAR StoreServ supports file-based storage using the HP X9300 Network Storage Gateway creating a platform for a consolidated storage infrastructure that requires file and block storage.
7. HP 3PAR StoreServ integrates with the server environment connected to it using the Host Explorer software. This software, installed on the server, reports configuration details like OS version, WWN of HBAs, iSCSI details and multipathing information. It is available for Windows, Red Hat Linux, Solaris on SPARC and VMware.
8. HP 3PAR StoreServ is fully compatible with Microsoft Hyper-V on Windows Server 2008 and 2012 for all aspects of the HP 3PAR thin technologies, Dynamic and Adaptive Optimization, Virtual Copy, and Remote Copy replication.
9. HP Data Protector integrates with HP 3PAR StoreServ via the Microsoft Volume Shadow Copy Service (VSS). Data Protector implements a fully automated, zero impact backup by creating point-in-time replica of the production volumes.

[8] **http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA4-0280ENW.pdf**
[9] **http://www8.hp.com/us/en/products/data-storage/data-storage-products.html?compURI=1284456**

Local replication

In business-critical environments, users require solid protection for their valuable data sets. To help users protect data in the most efficient way, local replication software implements snapshot and volume copy/mirror capabilities. With local replication, data and services can be restored in seconds or minutes if data was lost or corrupted.

The local replication software on EVA P6000 is called Business Copy. This software is array-based and implements point-in-time Vdisk copy objects called Vsnaps, Snapclones, and MirrorClones.

The local replication software on HP 3PAR StoreServ is called Virtual Copy and Full Copy (also known as Physical Copy). A Virtual Copy is a reservationless, space-efficient snapshot of a thin or a fat virtual volume. You can take virtual copies of base volumes, of full copies, and of other virtual copies. Similar to EVA P6000 a virtual copy only records the changes to the original volume using Copy-on-Write and no propagation of these changes are applied in chains of snapshots. Virtual copies can be created in a CPG that is different from the one of the base volume. A maximum of 500 virtual copies of a single base volume can be created with up to 256 read/write copies. Any virtual copy in the snapshot tree can be mounted to a host. For rapid rollback in case of an incident, the changes stored in a virtual copy can be copied back onto the base volume. This is called the “promotion” of a snapshot. Snapshots get deleted when no more space is available in a CPG on an HP 3PAR StoreServ system.

Simultaneous virtual copies across multiple volumes happen when their source volumes are added to an HP 3PAR Consistency Group. This concept also allows execution of management tasks on multiple volumes with a reduced number of mouse clicks. A single Consistency Group is limited to 100 virtual volumes. Virtual copies are consistent at the virtual volume level, but not at the host file system or application level. The optional HP 3PAR Recovery Manager Software flushes application and file system buffers to disk before taking the snapshot enabling application-level consistent snapshots.

HP 3PAR Full Copy is a local replication option to create thin-aware, point-in-time clones of a virtual volume in the same or another CPG. The destination volume must be created upfront. A resync of the full copy object with the original source is possible. A Full Copy volume can be promoted to an independent base volume by breaking the association between the Full Copy and its source. Full Copies can be managed in Consistency Groups.

The HP 3PAR Online Copy feature creates a copy of a virtual volume that is immediately available for access to hosts. Online Copy creates the destination volume automatically and can only be started from the CLI. Use cases of Online Copy include the creation of copies of volumes for backups or read-only data access.

The maximum number of local replication objects that can be created on a HP 3PAR StoreServ depends on the maximum combined number of base volumes, virtual, and full copies. Their sum cannot exceed 8192 objects on an HP 3PAR StoreServ F-Class and a 7000 and 12288 on a 10000.

Remote replication

Remote replication is the copying of data from selected virtual disks from a source (local) array to related virtual disks on a destination (remote) array. Applications continue to run while data is replicated in the background. The goal of remote replication is to the restart the service using the remote data copy minutes after a primary site failure.

The remote replication software for EVA P6000 is called Continuous Access (CA). This software is array-based and replicates data over almost any distance between HP EVA P6000 systems. The key object in Continuous Access is the Data Replication (DR) group being a logical grouping of one or more virtual disks on the source array in a remote replication relationship with a corresponding DR group on the destination array. The virtual disks in a DR group fail over together, share a DR group log, and preserve write order within the group.

HP 3PAR remote replication is called Remote Copy (RC). Like on EVA P6000, it is array-based. Remote Copy operations are performed on groups of volumes called Remote Copy Volume Groups. Group members keep write-order consistency in Remote Copy operations. Full, thin, and R/W snapshots can be part of a volume group. The maximum number of volumes per Remote Copy volume group in synchronous and asynchronous periodic mode is 100. Maximum 800 VVs per array can be replicated synchronously, for asynchronous replication the maximum is 2400 volumes. The setup and management of Remote Copy runs either from the Management Console or from the CLI. The transport direction between the HP 3PAR StoreServ systems can be unidirectional or bidirectional.

Next to FC interconnectivity, HP 3PAR RC also supports IP replication: every controller node has a 1 Gb/s Ethernet port dedicated to RC. RCFC (RC over FC) and RCIP (RC over IP) can be configured on the same array. On HP 3PAR StoreServ F-Class and the 10000, the HBAs used for RCFC links must be reserved for exclusive use by Remote Copy. On the 7000, host ports can be configured along with one RCFC port on the FC card in the PCI-e slot of the controller. Changing from RCFC to RCIP as the transport protocol or the reverse is possible but requires downtime on the synchronization link. The network for RCIP has to be a dedicated one but it does not need to span the WAN because the IP packets can be

routed through a gateway per IP link. Replication via the MPX200 over FCIP is supported but no integration with the HP 3PAR Management Console is available. In contrast with EVA, the destination VVs needs to be created explicitly by the system administrator before setting up RC. Replication is supported between any HP 3PAR StoreServ model but the systems need the same or an adjacent HP 3PAR OS release level. To take advantage of the new Remote Copy features in HP 3PAR OS 3.1.2, each HP 3PAR StoreServ in the replication setup needs to be at this OS level including the MU level if any. Replication from full to thin volumes or the reverse is supported and is thin provisioning aware. Direct FC connectivity for replication between arrays is not supported. Reversing the replication for failback is possible. Adaptive Optimization (AO) supports RC but until failover, the AO policies on the destination array should remain disabled. An RC operation can be stopped and resumed at any moment. Seeding the target volumes with backup data from the primary ones before activating an RC configuration speeds up the first data synchronization between systems.

Four distinct RC configurations for replication between HP 3PAR StoreServ systems are supported: 1:1, N:1, 1:N and Synchronous Long Distance (SLD). In SLD, one or more Volume Groups on the source system replicate to a nearby system and also to a more distant system. The nearby and the distant system have a replication link configured in standby mode. When the link between the source and the distant system malfunctions, this standby link gets activated. Note that a Volume Group on the source array cannot be replicated to multiple destination arrays except in the case of SLD.

HP 3PAR Remote Copy replicates in the synchronous or asynchronous mode. RC Synchronous mode is the same as in EVA P6000 Continuous Access. Asynchronous replication is called “HP 3PAR Asynchronous Periodic Remote Copy” and differs from EVA P6000 CA in that the asynchronous replication updates do not happen continuously but on a periodic basis. The minimum period between two replication updates for Asynchronous Periodic RC is five minutes with a maximum of one year. Multiple writes to the same location are replicated only once if those writes occur within one replication period; this saves replication link bandwidth.

Every RC setup is defined with a set of supported combinations of replication modes, transport layers, and transport directions. Consult the **HP 3PAR Remote Copy 3.1.2 Software User’s Guide** and your HP Representative or HP Partner for more details.

Peer Persistence for HP 3PAR StoreServ moves applications on VMware and their HP 3PAR StoreServ to a secondary data center for maintenance, load balancing, or disaster recovery without I/O disruption to the applications. Synchronous replication is required between the HP 3PAR StoreServ systems on the two sites. Peer Persistence is part of the HP 3PAR Storage Federation concept and is built on the HP 3PAR Remote Copy Software.

Remote Copy is an integral part of HP CLX and HP MetroCluster for HP 3PAR StoreServ. HP ContinentalCluster is not supported on HP 3PAR StoreServ.

Data migration

Data migration is the one-time relocation of data from a source system to a destination system. Migration can be host-based, appliance-based or array-based. Ideally, the migration occurs without downtime for the applications using the data.

EVA P6000 Continuous Access and HP 3PAR Remote Copy are the array-based solutions for data migration between members of an array family. Host-based migration is feasible between similar or heterogeneous arrays. In the latter, the coexistence of the multipathing software for both array types on the OS of the server has to be verified upfront.

Both EVA P6000 and HP 3PAR StoreServ support the MPX200 Multifunction Router appliance for high performance online or offline data migration with enterprise-class high availability and no single point of failure. Besides intra-family migrations, any HP 3PAR StoreServ can be the target of a data migration from an EVA using the MPX200. This appliance installs in the data path between a host and the storage system. It provides FC, iSCSI, and FCIP as transfer protocols between the MPX200 and the arrays to be migrated. Data compression during migration is optional. Capacity- and array-based licenses are available. Migration from fat volumes on the source array to thin volumes on the destination is supported.

A unique tool for data migration between EVA P6000 and HP 3PAR StoreServ is HP 3PAR Online Import. All stages of the migration cycle are orchestrated from within P6000 Command View GUI without complex planning or a dependency on extra tools or external hardware. Data transfer is unidirectional from the EVA P6000 to the HP 3PAR StoreServ and online for volumes presented to VMware, Red Hat and SUSE Linux and Solaris. On Windows, Online Import is minimally disruptive requiring a reboot of the host for a SAN rezoning operation. Online Import supports EVA 4/6/8x00 and P6000. The destination HP 3PAR StoreServ has to run HP 3PAR OS 3.1.2. Leveraging the Thin Built-In technology in HP 3PAR StoreServ, Online Import enables the conversion from fat volumes on EVA P6000 to thin volumes on the HP 3PAR StoreServ. The same data migration concept is implemented between two HP 3PAR StoreServ systems and is called Peer Motion.

Data migration services[10] are available from HP for migrations from EVA P6000 to HP 3PAR StoreServ and between HP 3PAR StoreServ systems.

Multisite clusters

In multisite server clusters, applications and array replication are integrated for a tight cooperation. The applications are active on the primary site and can be in active or standby mode on the secondary site. Failover to the secondary site happens automatically when the cluster software determines that it has lost communication with the server running a workload or with its storage system on the primary site.

HP offers the Cluster Extension (CLX) software for EVA P6000 and HP 3PAR StoreServ for Windows or Linux hosts. Cluster Extension enables write access to remote data copies when local systems fail. It requires no server reboots or LUN presentation/mapping changes delivering true hands-free failover and failback for the applications under CLX protection. Application failover is leveraged from Windows Clustering and from HP Serviceguard for Linux. For the data replication part use is made of HP 3PAR Remote Copy. For applications running on HP-UX with HP 3PAR StoreServ systems, HP MetroCluster provides long distance disaster tolerance.

HP 3PAR StoreServ integrates with VMware vCenter Site Recovery Manager (SRM) for a complete Business Continuity solution based on VMware. This integration is achieved through freely downloadable Storage Replication Adapter (SRA) software, created by HP. This software support automated failback and planned failovers with version 5.0 of VMware SRM.

Optimization

Modern storage systems support multiple tiers of storage with a wide range of capacity, performance, and cost characteristics. The performance and cost of a system can be optimized by appropriate placement of data on suitable tiers. Although allocating data to the proper storage tier is a standard task for storage administrators, the real challenge is to migrate the data to their optimal tier in the system in an automated, reactive way. In this migration sub-LUN tiering is recognized to be the superior technique.

Storage tiers on EVA P6000 systems are created from disk groups with different drive media type, drive speed, and drive size. RAID level can be an additional tier level for performance or protection. The EVA P6000 supports the online migration of entire Vdisks between RAID levels within a particular storage tier and between storage tiers with the Dynamic LUN Migration Software. This software is array-based, part of the Business Copy software and included with the P6000 Command View license. Thin provisioned volumes, snapshots, and Vdisks in BC or CA relationship cannot be migrated to another tier. Automation is available through scripting using the CLI tool called Storage System Scripting Utility (SSSU). Sub-LUN tiering is not supported.

In HP 3PAR StoreServ the storage tiers are the CPGs present in the system. HP 3PAR's Dynamic Optimization (DO) software offers the functionality of EVA's Dynamic LUN Migration: volumes are migrated online to another CPG with a different RAID level, set size, drive media type, etc. This DO migration or "tuning" can be started for individual base volumes, their snapshots and Full Copies, for all volumes inside a CPG or for the entire array. The creation of tune tasks happens in the Management Console or the HP 3PAR CLI. Automation of DO using the `tunesys` command is possible through scripting in the CLI.

The HP 3PAR Adaptive Optimization (AO) software takes optimization a step further into sub-LUN tiering. AO migrates sub-LUN data across CPGs based on user-defined policies. Two or three CPG tiers can be specified per policy; all volumes inside a CPG are subject of an AO policy. AO policies usually operate on an FC and NL tier or on an SSD, FC, and NL tier. This tool can improve system response and reduce disk acquisition cost by storing frequently accessed data in the faster tier while moving infrequently accessed data to the slower and cheaper slower tier. AO is part of the HP 3PAR System Reporter (SR) Software that monitors all storage resources on an HP 3PAR StoreServ. Since HP 3PAR OS 3.1.2, the AO and the SR software execute directly on the nodes of an HP 3PAR StoreServ eliminating the need for an external server running this software.

The granularity of an AO data migration is a region of 128 MB in size. A set of algorithms in AO makes decisions on region migrations based on the continuous collection of I/O access patterns to logical disks (LD) across the system. AO is not real-time but reactive: based on the policy, region migrations start after 3 hours to 6 days of collecting I/O pattern information. Policies can be scheduled to be inactive during certain periods like the weekend to prevent data migration to the lowest tier because of no I/O activity on Saturday and Sunday. The AO algorithms do not deal with the content of the volumes on an HP 3PAR StoreServ, they analyze and moves regions independently of the VV structures. An AO policy can control the maximum space available for each tier. For example, an AO policy containing a CPG on SDD can set a limit to the consumption of SSD space optimizing the use of the top tier for other applications or user groups.

[10] **http://www.hp.com/us/en/software-solutions/software.html?compURI=1078353**

Availability and resiliency

All mid-range and high-end storage arrays are designed for business critical applications. They have built-in redundancy features that enable the array to continue operation in the event of a wide variety of failures. Nevertheless, best practices for high availability should be adhered when installing and configuring arrays.

All EVA P6000 and HP 3PAR StoreServ models meet today's standards for availability and resilience: they are equipped with redundant power supplies, power distribution units, fans, cache batteries and controllers and they have redundant paths from a controller pair to the disk enclosures. RAID levels protect the data against failing physical disks.

The disks within disk groups on the EVA P6000 are organized in subgroups of 6 to 11 disks called Redundancy Storage Sets or RSS. Each RSS contains sufficient redundancy information to continue operation in the event of a disk failure within that RSS. This means the EVA can sustain multiple simultaneous disk failures without losing user data, as long as no more than one disk per RSS fails.

An HP 3PAR StoreServ contains CPGs that group disks, preferably all of them of the same media type. CPGs are created with port, drive magazine, or cage (drive chassis) levels of availability. These policies determine from which physical disk drives the HP 3PAR OS takes chunklets to assemble them in Logical Disks. Drive Magazine level availability means that a logical disk can tolerate a drive magazine failure, cage level availability means that a logical disk can tolerate an entire drive chassis failure containing up to 40 disk drives. Port level availability is the same as cage level for HP 3PAR StoreServ 7000 and 10000 systems, it only comes into play when daisy-chaining drive chassis in the HP 3PAR StoreServ F-Class.

HP 3PAR OS implements a unique feature in the industry called HP 3PAR Persistent Cache. This resiliency feature preserves write-caching in the event of loss of a controller node on systems with four nodes or more. In case of a node failure, Persistent Cache rapidly mirrors the cache of the surviving node of the node pair to one of other nodes in the array. That means we always have 2 copies of a node's cache in the system.

The HP 3PAR StoreServ 7000 and 10000 systems implement the T10 Data Integrity Field (DIF) standard that protects data on disk from silent corruption. Each data block of 512 bytes is complemented on the HBA level with 8 bytes of protection data. To accommodate the extra 8 bytes, disks on HP 3PAR StoreServ 7000 and 10000 systems are formatted in 520 byte sectors. Operating systems and applications need no changes to make use of this additional protection.

In the HP 3PAR Persistent Ports feature, every host-facing port of an HP 3PAR StoreServ can assume the identity of a predesignated partner port located in the adjacent controller node. This enhances high availability during non-disruptive node software and HBA firmware upgrades: the host path on a particular HBA appears to remain online for the multipathing software even though the node or the HBA is brought down. HP 3PAR Persistent Ports works with FC and iSCSI on every HP 3PAR StoreServ system running HP 3PAR OS 3.1.2.

Event management

Event reporting and its proper management are very important in the maintenance of a storage device. Local and remote event log reading and event forwarding to central management stations are requirements.

P6000 Command View maintains three separate log files: Management Server Event Log, Controller Event Log and Controller Termination Event Log, all stored on the Windows server running P6000 Command View. Extreme detail (>10000 lines) for every event can be viewed from within P6000 Command View but may only be useful for trained HP support personnel. P6000 Command View also logs events in the Application section of Windows Logs.

The HP 3PAR StoreServ Management Console (MC) displays the events from every HP 3PAR StoreServ systems it was logged in to. The MC differentiates between "Alerts" that require operator intervention and "Events" that are entries created in response to user- or system-generated activities. The combined log file for them is maintained on the array itself, forwarded to the Service Processor (SP) and from the SP to HP where the data can be browsed securely online. The maximum log size can be limited. Events and alerts can be read and filtered with extensive criteria from within the MC or the CLI. Events can be pushed to a remote log host but no filtering is possible on the array. The SPOCC application on the Service Processor is another, web-based interface to review logs and files maintained on the array.

An SNMP Agent integrated in HP 3PAR OS generates notification messages (traps) for alerts and events. The SNMP agent converts all alerts and events into SNMPv2 traps and forwards them to the SNMP management stations that have previously registered with the agent. The CIM server integrated in HP 3PAR OS supports CIM Indications as the mechanism for the delivery of alerts and events to a CIM client like HP SIM. Event reception and management through Storage Essentials is not supported. If the Service Processor stops working, the Monitoring System at HP 3PAR generates a File Transfer Overdue (FTO) alert that triggers an alarm four hours after having received the last message from a particular HP 3PAR StoreServ. SNMP trap and CIM alerts are still sent to the configured email addresses when the Service Processor is down.

Security

Data is the most critical asset of a customer's business. Access to tools that manage a system can lead to loss of information or the illegal duplication of it to rogue servers. Extended security features protecting the data against outsiders are high on the list of corporate buyers.

Access to the HP 3PAR Management Console is by http or https. The HP 3PAR OS CLI client communicates by default securely over SSL with the CLI server on the HP 3PAR StoreServ using TCP port 5783. This port can be changed. Access to the CLI server on the system is also possible via SSH. The only supported protocol for communication to the Service Processor is SSH.

Accounts to access a HP 3PAR StoreServ reside locally on the array or on an LDAP or Microsoft Active Directory (AD) server. An account is assigned one of eight roles that each have a set of rights determining which tasks a user with a particular role can perform within the system. There are four standard roles named Browse, Edit, Super and Service and four extended roles named Create, Basic Edit, HP 3PAR AO (Adaptive Optimization) and HP 3PAR RM (Recovery Manager). The extended roles have rights optimized for users with specialized or restricted tasks. User management is HP 3PAR Domain aware enabling the assignment of fine-grained privileges over system objects such as volumes and hosts.

The Management Console Audit Log registers user activities in the Management Console. The log files are located at `\Users\<username>\InformMC\log` and grow to 10 MB in size before a next one is created. All CLI and SSH commands and GUI activities that result in CLI activities are logged and can be shown with the `showeventlog` CLI command on the local array. These events are also transferred to the Service Processor. The Service Processor supports Policy Manager and Keystroke Recording from version SP 2.5.1 MU1 onwards.

Licensing

EVA P6000 systems come with factory-installed instant-on license keys with unlimited capacity for 60 days starting from the day of first use. All EVA P6000 software products are offered only as frame-based licenses since 2011.

The licensing scheme for HP 3PAR software products is a mix of spindle/magazine-based, consumption-based, frame-based, and free licenses. An example of a consumption-based licensing scheme is Thin Provisioning where the raw space in use by data in TPVVs is taken as the metering criterion. Virtual Copy and Remote Copy are examples of spindle-based licensing while the Recovery Manager software is on a frame basis. The HP 3PAR Host Explorer Software is available for free. HP 3PAR StoreServ 7000 comes with a free 180-day Online Import license to facilitate the data migration between an EVA P6000 and an HP 3PAR StoreServ system. Evaluation licenses for 180 days for any HP 3PAR software title can be obtained from HP. HP 3PAR licenses are array-locked and the number of controller nodes is taken into account. Licenses are not transferrable between systems.

The licensed features on a system can be viewed from the Management Console or the CLI. Licenses can be installed on the array using the CLI only. The original license keys can be retrieved using the CLI.

Upgrading the system

HP designed the EVA P6000 systems to enable the highest degree of Customer Self Install, Upgrade, and Repair for the hardware components and firmware. Hardware upgrades include adding more disk drives and disk shelves. The EVA P6000 controller firmware and disk drive firmware can be customer-upgraded from within P6000 Command View while hosts have uninterrupted access to their data.

HP 3PAR StoreServ systems equal or surpass the upgrade and expansion possibilities of EVA P6000 systems. Only the HP 3PAR StoreServ 7000 supports Customer Self Install, Upgrade and Repair; with all other models HP 3PAR support people will replace physical components in the system and execute OS and disk firmware upgrades. Hardware and software/firmware upgrades are initiated by executing the appropriate script on the Service Processor (SP), which places the HP 3PAR StoreServ in a predefined state before any changes to it are made. Upgrades of the Service Processor itself are installed via an image drop from CD.

Controller nodes, drive chassis, and drive magazines can be added online. HP 3PAR StoreServ systems cannot be upgraded to a different class, for example from a 7000 to a 10000 or to a different model within the same class for example from a 10400 to a 10800 model. Non-cumulative patches for HP 3PAR OS are issued at an infrequent basis either addressing problems or enabling new hardware. Disk drive firmware upgrades happen non-disruptively.

HP 3PAR OS updates on the controller nodes may either be performed online or offline. Online updates allow the hosts connected to the system to continue I/O activity, for offline updates host I/O activity must be stopped. The following types of updates are supported:

- Half-System Online Update: Used for a major OS-level change, for example updating from 2.3.1 to 3.1.1. Half of the nodes are updated at a time, the other half of the nodes are updated after that. This allows the upgrade of the HP 3PAR OS concurrently with I/O activity on the attached hosts, provided documented SAN design conditions are met.
- Single-Node Online Update: Used when the OS maintenance level changes, for example updating from 2.3.1 MU3 to 2.3.1 MU5. Each individual node in the HP 3PAR StoreServ is updated at a time. This type of upgrade is also used when doing a major OS-level upgrade from 3.1.1 going forward. Although the total time to perform a single-node online update is longer than a half-system online update, the impact on the system is less because all but one of the nodes remain available to the hosts. The update takes approximately 20 minutes per node. That includes the time for the user to verify the node came back up and services I/O.
- All-Node Offline Update: Used when the system is operating several levels below the update package version. In this case, the update is performed without all the system checks required for online updates. All nodes are updated and rebooted at the same time.

Downgrades of the HP 3PAR OS, even on the MU level, are always offline. Refer to the latest version of the HP 3PAR OS Upgrade Pre-Planning Guide at **hp.com/go/3par**.

For online updates, all hosts must be compliant with the currently applicable Implementation Guides for the target HP 3PAR OS level. No host or environment changes should be performed during an online update (for example, rebooting a host, applying patches, or rezoning switches). The HP 3PAR OS update software performs an automatic check for failed or degraded physical disks, drive chassis and nodes and for redundant FC loops to disk chassis before starting the upgrade. The update software checks for the existence of hosts before and after each step. If host connections do not reappear after a particular step, the update process reverts to the original level in the case of a half-system online update and will not continue in the case of a single-node online update.

The **HP 3PAR Storage System Installation and Startup Service**[11] offers deployment of hardware and firmware upgrades to your new or existing system and the activities required to present the upgrade products to designated hosts.

[11] **http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA2-8240ENW.pdf**

System performance monitoring

Performance monitoring of all critical parameters of a storage system on a continuous basis is essential in managing a storage system. The scheduled creation of reports on the main performance parameters is part of a comprehensive monitoring plan.

HP EVA P6000 makes use of EVAPerf to provide detailed performance statistics on EVA systems on a wide range of metrics. The application is bundled with P6000 Command View and integrates with the local Windows Performance Advisor tool. EVAPerf also has an extensive command line interface and produces reports in CSV and TSV format. Since P6000 Command View 10.x, the P6000 Performance Advisor software is integrated in the array management interface.

The HP 3PAR Management Console includes a section for viewing real-time performance graphs on host and disk I/O. For more detailed and historical reports, HP 3PAR offers the System Reporter Software (SR). This is a licensed product offering access to historical performance, capacity management, chargeback and Adaptive Optimization (AO) data on one or more HP 3PAR StoreServ systems. A large collection of embedded reports is available complemented by the option to generate custom reports. System Reporter can be configured to send email alerts when certain metrics do not meet specified conditions, for example when the average read service time of a VLUN exceeds 100 ms within a sampling interval. The description of the System Reporter database schema is provided as a convenience to those wishing to query the database directly.

Starting with HP 3PAR OS 3.1.2, System Reporter is integrated into the OS running on the controller nodes. One can still deploy System Reporter on a separate server and collect performance data on HP 3PAR StoreServ systems running 3.1.2 and prior versions. When installed on a separate server, the included SQLite database for storing the collected data is not recommended beyond testing the product. Microsoft SQL, MySQL, and Oracle are supported as production-quality databases but are not provided with the product. System Reporter can be installed on a physical server or a VM running Windows or Red Hat Enterprise Linux. When installing System Reporter on a VM, it is advised to run the database on a separate VM. Sizers for servers that will run System Reporter are available from an HP Representative or HP Partner.

Monitoring the arrays and reviewing performance data is done using a standard web browser, the HP 3PAR CLI, or a Microsoft Excel client. The latter offers additional customization options not available when using the web-based interface. MC 4.3 and the HP 3PAR CLI for 3.1.2 contain a number of enhancements and new commands to extract performance information from HP 3PAR StoreServ systems with System Reporter integrated. Report data can be exported to CSV files for import into data analysis tools.

Conclusion

If you are an EVA user, then HP 3PAR StoreServ is everything you would want in a next generation EVA. With many features shared between the products including virtualization and wide-striping, and with the advanced features in HP 3PAR StoreServ like virtual domains, cache persistence, thin technologies and storage tiering software, moving to HP 3PAR StoreServ is a natural progression for EVA customers. With the HP 3PAR StoreServ Online Import feature, moving your data from EVA to 3PAR StoreServ is efficient and very cost effective. Because the migration is initiated with HP Command View EVA, it's easy too. HP 3PAR StoreServ 7000 is an agile Tier 1 storage platform with midrange affordability and the lowest risk upgrade for EVA users.

References

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Architecture Paper for HP 3PAR StoreServ 10000: **http://h18006.www1.hp.com/storage/pdfs/4AA3-3516ENW.pdf**

Animation of the HP 3PAR StoreServ disk layout: **http://h30507.www3.hp.com/t5/Storage-Illustrated/Visualizing-3PAR-s-disk-architecture/ba-p/100795**

For more information

To know more about HP 3PAR StoreServ arrays, visit **hp.com/go/3PAR**.

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Current HP driver, support, and security alerts
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4AA4-3999ENW, Created December 2012